

**A Sexual Aberration in the Red Rust Flour Beetle,**  
***Tribolium castaneum***  
(Coleoptera : Tenebrionidae)

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Hermaphroditism and intersexuality are common throughout the animal kingdom, the former being functional in many animal groups and the latter resulting from genic or chromosomal disturbances in otherwise normal individuals.

Among insects, functional hermaphroditism is present in some species of scale insects of the genus *Icerya*; the stonefly, *Perla marginata*; and possibly the phorid fly, *Termitoxenia* (Hughes-Schrader, 1948). In *Icerya* and *Perla*, an ovotestis is present which differentiates both male and female gametes.

In addition, isolated examples of intersexes and hermaphrodites have been reported in a number of insects (e.g., Baynes, 1960; Weinreich, 1962; see also Balazuc, 1948). To our knowledge, no cases of hermaphroditism or intersexuality have been found among tenebrionid beetles. It is the purpose of this report to describe a single incidence of a possible hermaphrodite or, more probably, an intersex in the flour beetle, *Tribolium castaneum* Herbst.

The individual in question was discovered in the pupal stage in a strain of *T. castaneum* which had been selected for fast development. The selected line originated from the University of California synthetic stock described by Lerner and Ho (1961). The pupa was immediately isolated and, after a drawing had been made, was transferred to a vial of fresh flour to await eclosion.

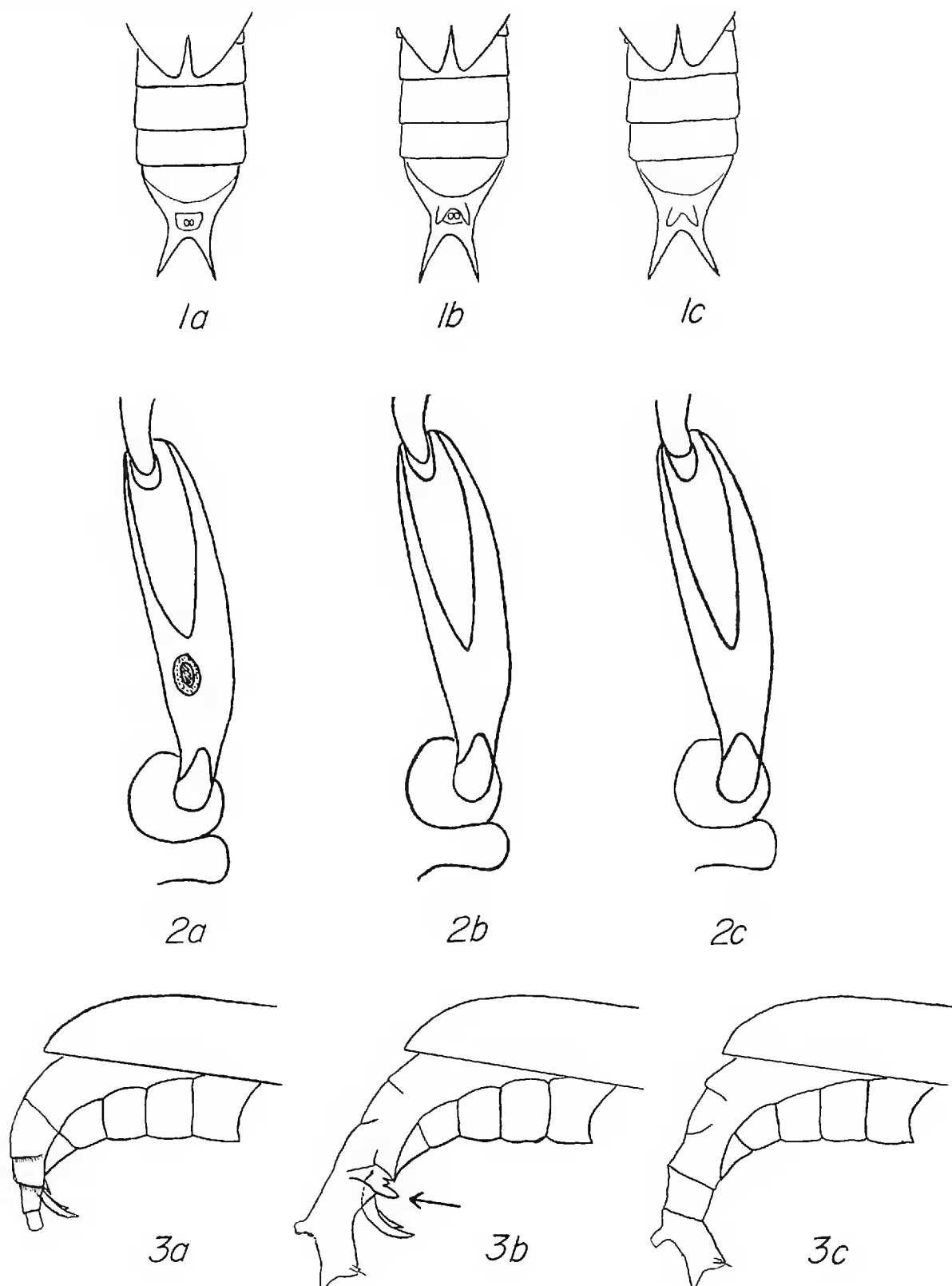
The appearance of this pupa is contrasted with that of normal male and female pupae in Fig. 1. In addition to seemingly normal female genital lobes, a pair of medial, small genital lobes resembling somewhat those of normal males was observed.

After eclosion, the adult beetle was examined further. Males of this particular species of flour beetles are characterized by possession of a secondary sex "spot" on the femur of the first pair of legs which is absent in females. The aberrant individual had no sex spot, indicating that it was female (Fig. 2).

However, examination of the abdomen revealed the presence of a distinct penis and a pair of fleshy, partly sclerotized claspers. In addi-

tion a definite ovipositor, albeit abnormal, was present. Fig. 3 compares the appearance of the genitalia of this imago with that of normal males and females.

The presence in this individual of structures at the base of the penis resembling "claspers" is puzzling. Normal males of this species do not possess such structures, although they are present in a closely related species, *Tribolium confusum* Duval. Even there they are definitely not sclerotized as in the abnormal beetle.



Attempts were made to mate the aberrant adult, first with females and then with males, but no progeny were obtained. This may have been due in part to the fact that the genitalia were abnormally extended from the abdomen and could not be retracted. This has been observed in our laboratory to result in sterility when it occurs in otherwise normal beetles.

After "mating" with normal males the beetle was found in moribund condition and placed in fixative to preserve the internal tissues for cytological observation. The fixed abdominal contents appeared more like testicular than ovarian tissue. These tissues were serially sectioned and observed for the presence of bisexual gonads (gonads appeared to be of only one sex) and for chromosomal abnormalities. Unfortunately no chromosomes could be found in any of the sections.

That this is not a usual case of hermaphroditism is evident from Figs. 2 and 3. The femurs of both front legs were obviously female since no trace of a sex spot was observed. The genitalia included a distinct aedeagus and ovipositor and, in addition, a pair of supernumerary "claspers." The failure of cytological studies to shed any light on the situation makes explanation of the observations difficult.

A somewhat similar situation has been observed in *Homoeogryllus japonicus* (Ohmachi, 1935; reviewed in White, 1951). A strain of this species of cricket produced some genetically male individuals in which

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#### EXPLANATION OF FIGURES

Fig. 1. The posterior ends of a normal male (1a), a normal female (1c), and the aberrant (1b) pupae in *T. castaneum*. Note that, in the latter, genital lobes characteristic for the two sexes are present (20 ×).

Fig. 2. Left forefemur of a normal *T. castaneum* male (2a), the aberrant beetle (2b), and a normal female (2c). The basal pit with associated hairs, a secondary sex character restricted to males, is absent from the femur in the aberrant individual (80 ×).

Fig. 3. Semischematic lateral views of the extruded genitalia in a normal male (3a), the aberrant individual (3b), and a normal female (3c) in *T. castaneum*. Note that the aberrant individual has a distinct aedeagus and an ovipositor, combining the genital organs of both sexes in one individual. In addition, the hermaphrodite or intersex (3b) possessed a pair of movable, sclerotized, "claspers" (arrow) which are normally absent in *T. castaneum* but are present in *T. confusum* (25 ×).

the tegmina were altered so as to appear somewhat female in appearance. This change was shown to be due to a sex-linked mutation.

It is possible that the present abnormality resulted from a comparable mutation which modified a genetically female individual into the observed intersex. Since no sibs of the affected beetle were available, further breeding tests could not be carried out.

Although Smith (1952) has shown that an X-Y pair of sex chromosomes is present in *Tribolium*, it is not known whether sex determination is regulated by a balance between sex chromosomes and autosomes or by the presence-absence of the Y chromosome. If the former mechanism is correct, as is the case in *Drosophila* (Bridges, 1925), then the abnormal beetle could be an intersex which resulted from a disturbance in chromosomal balance. This seems to us to be the most plausible explanation.

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